EVN Observations of GRS1915+105

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1. Introduction

The source GRS1915+105 is an X-ray transient source, at a distance of 11 kpc, which represents the first case of apparent superluminal motion in a source within our own Galaxy (Mirabel and Rodriguez 1994, Fender et al. 1999). The source, constantly monitored in radio frequencies at the Green Bank Interferometer (GBI), shows quiescent periods, with radio flux densities of a few mJy, periods of radio activity, with fluxes around 200-300 mJy at 2.2 GHz, and rapid major flares, up to 1 Jy or more. The growth of the flares is very rapid, usually hours. The decay of the flux density is quite rapid too, since in only 5-6 days the source emission drops to the level of 200 mJy or less.

2. Observations and Results

We obtained EVN observations aimed at observing the source in a radio-loud state (Fig. 1). Target Of Oppurtunity (TOO) observations were performed during gaps of the official observing schedule on 31/05, 02/06 and 09/06 (1998) at 6 cm, 6 cm and 18 cm, respectively. Integration times were of about 4 h in each observation.

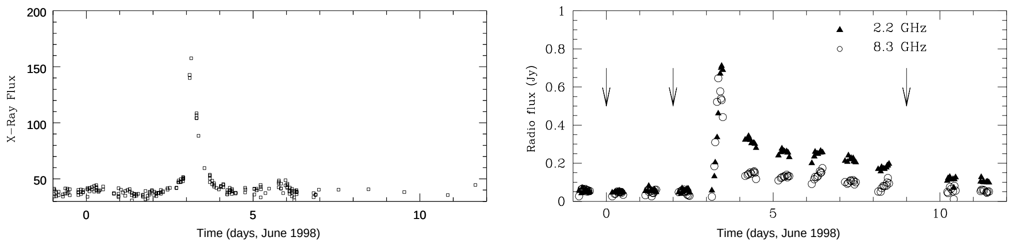

FIGURE 1. Source light curve in X-rays (XTE, left) and in radio (GBI, right), with arrows indicating the epochs of the EVN observations.

The telescopes involved in the observations were Medicina, Noto, Effelsberg, Jodrell Bank, Onsala, Westerbork and Torun. The data have been calibrated at JIVE (Dwingeloo). Source images (Fig. 2) have been produced with the AIPS package.

In the two images obtained before the major flare, the source is resolved, showing two opposite asymmetric jets. The main jet is in the Southeast direction in position angle $\sim 160°$, consistent with the orientation of the main jet present in previous MERLIN and VLA images (Fender et al. 1999, Mirabel & Rodriguez 1994). The total source extent is of $\sim$13 mas, corresponding to 2.1 $\times 10^{15}$ cm ($\sim$140 AU). The total flux density

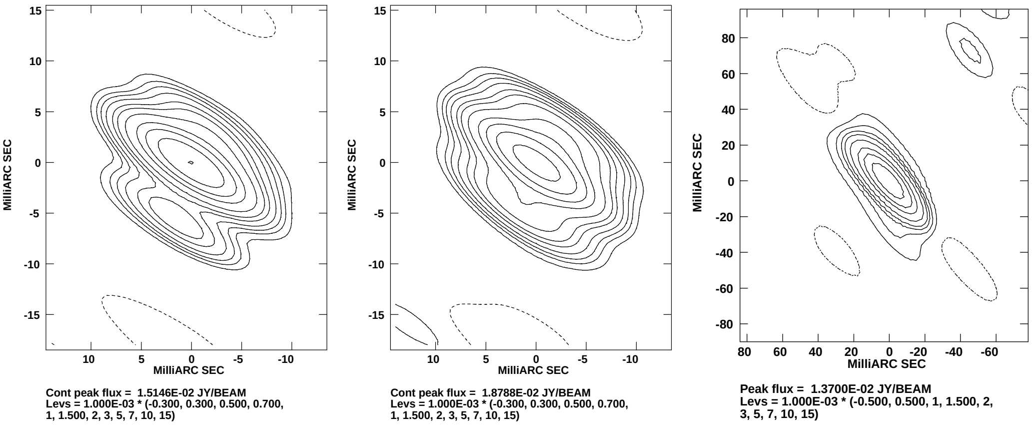

FIGURE 2. Images of the 3 EVN observations. The first contour is always at the 2σ noise level. Left panel: May 31 1998, 6 cm, HPBW = $10\times$ 3 mas, Central panel: June 2 1998, 6 cm, HPBW = $10\times$ 3 mas, Right panel: June 9 1998, 18 cm, HPBW = $39\times$ 12 mas

shows a slight increase (from 22 mJy to 31 mJy) between the two epochs. These flux measurements are roughly consistent with the GBI fluxes.

In the third observation, obtained after the flare, the source is unresolved. The total flux density is 17 mJy, much lower than the GBI flux. This would imply the presence of extended structure not detected in this third observation, supporting the idea that during the flare strong high velocity components have been ejected.

3. Discussion and Conclusions

From the present results, it is evident that steady jets exist in the source also before a major flare. This confirms the findings of Dhawan et al. (2000), but the jets detected in the present case are much more extended.

Assuming that the jets are relativistic and intrinsically symmetric, we can derive an estimate of the velocity from the jet to counter-jet brightness ratio and from the jet-length ratio. Using a source orientation to the plane of the sky of 66° (Fender et al. 1999), we derive a range for the velocity of 0.2-0.6c, up to a distance of $\sim$8 mas ($\sim$ 90 AU). With this velocity, we would expect to detect proper motion between the two images of May 31 and June 2. This is not observed, the source structure being rather stable. The absence of proper motion could be due to a continuous ejection in a stable jet.

By comparing the present velocity estimate with the superluminal velocity measured after a major flare, we suggest that the flare is producing a strong ejection at much higher speed. The high resolution image obtained by Dhawan et al (2000) before a major flare, shows a quite symmetric source on a scale of $\sim$50 AU, with a jet velocity of $\sim$0.1c. The result obtained from the present data would imply that the jet accelerates at a distance between 50 AU and 90 AU from the black hole.

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